REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
FINAL WORK PLAN
EXTERIOR INDUSTRIAL WASTE DITCH
NAVAL REACTORS FACILITY
IDAHO FALLS, IDAHO

Appendix B

SAMPLING AND ANALYSIS PLAN

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SAMPLING AND ANALYSIS PLAN - OVERVIEW

This Sampling and Analysis Plan (SAP) is part of the Idaho National Engineering Laboratory (INEL)-Naval Reactors Facility (NRF) Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Industrial Waste Ditch (IWD). The SAP, the Health and Safety Plan (HASP), and the remainder of the Work Plan describe the technical approach and procedures to be used in completing the RI/FS tasks.

The SAP comprises three parts: Part A, the Field Sampling Plan (FSP); Part B, the Quality Assurance Project Plan (QAPjP); and Part C, the Data Management Plan (DMP). The FSP describes the methods and procedures that will be used during RI field investigation activities. The QAPjP describes RI data quality objectives, field and laboratory quality control samples, performance and system audits, data reduction, validation, and reporting. The DMP describes how field and laboratory data will be recorded, verified, and stored.

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
FINAL WORK PLAN
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Appendix B
PART A

FIELD SAMPLING PLAN

FIELD SAMPLING PLAN

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PART A

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ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Standards for Testing Materials
CAF	Corrective Action Form
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limits
CRQL	Contract Required Quantification Limits
CRL	Central Regional Laboratory
DI	Deionized
DMP	Data Management Plan
DOE	Department of Energy
DQO	Data Quality Objective
Eh	Reduction/Oxidation (Redox) Potential
EMSL	Environmental Monitoring and Support Laboratory
EPA	U.S. Environmental Protection Agency
FFA/CO	Federal Facilities Agreement/Consent Order
FSP	Field Sampling Plan
GC/MS	Gas Chromatograph/Mass Spectrometer
IBO	U.S. Department of Energy - Naval Reactors, Idaho Branch Office
IDHW	State of Idaho, Department of Health and Welfare
INEL	Idaho National Engineering Laboratory
IWD	Industrial Waste Ditch
LSSS	Laboratory Scientific Support Section
MP	Method Procedure
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPL	National Priorities List
OU	Operable Unit
OVA	Organic Vapor Analyzer
PCB	Polychlorinated Biphenyl
pH	Measure of acidity or alkalinity of a solution
PID	Photoionization Detector
PRP	Potentially Responsible Party
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAMP	Quality Assurance Management Plan
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
QAU	Quality Assurance Unit
QC	Quality Control
R	Recovery
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act

RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SAS	Special Analytical Services
SMC	Sample Management Coordinator
SMO	Sample Management Office
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	Semivolatile Organic Compound
SW846	Test Methods for Evaluating Solid Waste 1986
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure (RCRA)
TIC	Tentatively Identified Compound
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WAG	Waste Area Group

FIELD SAMPLING PLAN

1.0 INTRODUCTION

1.1 General

This Field Sampling Plan (FSP), Part A of the Sampling and Analysis Plan (SAP), describes the technical approach and specifies sampling methods and procedures that will be used in completing Remedial Investigation (RI) field investigation tasks at the exterior Industrial Waste Ditch (IWD).

1.2 Objective

The FSP's objective is to assure that all RI investigative field methods and procedures are appropriate, consistent, and reliable. Appropriate, consistent, and reliable methods generate data of known and acceptable quality which are suitable for use in the Baseline Risk Assessment and Feasibility Study (FS).

1.3 Organization

The FSP presents a detailed discussion of field investigation activities including:

- Collection of sediment samples from the IWD for chemical analyses
- Collection of sediment samples from the IWD for physical analyses
- Collection of dredge pile soil samples for chemical analyses
- Collection of dredge pile soil samples for physical analyses
- Collection of background samples for chemical analyses
- Drilling and subsurface soil sampling for physical property measurements and soil chemical analyses
- Ground water and surface water sampling and chemical analyses
- Ground water level monitoring
- Geophysical survey to identify shallow ground water and top of bedrock

This FSP is subdivided into two separate parts that best describe the scope of work to be performed in each area: Part A, the Surface Soil and Sediment Sampling Plan; and Part B, the Hydrogeological Investigation. The Surface Soil and Sediment Sampling Plan includes the IWD Surface and Sediment

Investigation, the IWD Dredge Piles Investigation, and additional background sampling. The specific tasks associated with the surface and sediment sampling plans are described in Section 2. Because the dredge piles represent specific impacts from discharges prior to 1976 into the IWD, the sampling and analyses of the dredge piles can provide an opportunity to characterize this material as a "snapshot" of residual contamination from previous waste discharges.

The Hydrogeological Sampling Plan includes Geophysical Investigation, Alluvium Characterization, Perched Water Investigation, Geochemical Analysis, and IWD Survey. The specific tasks associated with the Hydrogeological Sampling Plan are described in Section 3. This portion of the FSP has two primary objectives:

- To evaluate the presence of contaminants currently in the ground water and alluvium under the IWD;

- To assess the potential for migration of identified constituents from the IWD surface and sediment, soils and the adjacent dredge piles along the IWD.

2.0 IWD SURFACE AND SEDIMENT INVESTIGATION

2.1 Objectives, Data Needs, and Field Activities

The objectives of the surface and sediment investigation are to characterize the nature and extent of contamination in the surface and sediment from past discharges into the IWD, to evaluate potential migration of the contaminants into the ground water, and to characterize the nature and extent of contamination of the dredge soil materials which are piled beside the IWD for approximately 7,000 feet. Surface and sediment investigation objectives, data needs, and field activities for the IWD are presented in Tables A-2-1 and A-2-2.

2.2 Surface Soil and Sediment Sampling Locations and Purpose

The purpose of the samples will be to determine contaminant concentration for use in fate and transport modeling and risk assessment.

The IWD will be divided into four segments for this portion of the investigation as discussed in Section 4.3.1 of the Work Plan (see Figure A-2-1). The first segment will extend from the outfall of the IWD (0+00) downstream for 3,300 feet (station 33+00). The second segment will reach from 3,300 feet (station 33+00) to 6,600 feet downstream (station 66+00); the third segment will reach from 6,600 feet to 9,900 feet downstream (station 99+00). The fourth segment is the dry portion of the IWD which extends from 99+00 to the end of the IWD (station 169+00). The depths of these samples will be from the sediment surface 12 inches into the surface soils as discussed in Section 4.3 of the Work Plan.

This sampling plan will employ a staggered sampling pattern to locate sampling points. A sampling interval of 100 feet between sampling locations will be used to sample the first segment of the IWD (stations 0+00 to 33+00). Starting at the IWD outfall, the first sampling location will be the IWD centerline and as close to the outfall culvert as possible. The second sample will be located 100 feet downstream on the right side of the channel floor; the third sample will be 100 feet downstream in the center of the IWD. The fourth sample will be 100 feet further downstream and on the left side of the channel floor. The succeeding samples will be staggered so that each sampling location is selected as shown in Figure A-2-2. This sampling pattern will be used to locate the remaining samples in this segment and in the following three segments; however, the interval lengths will increase in subsequent segments. The sampling intervals for the second IWD segment will be 200 feet downstream beginning at 3,300 feet (station 33+00) as shown in Figure A-2-3. Sampling intervals for the third segment beginning at 6,600 feet downstream (station 66+00) will be spaced 400 feet apart as shown in Figure A-2-4. Samples will be collected every 800 feet on the fourth segment beginning at 9,900 feet using the same staggered sampling pattern discussed for the other segments (see Figure A-2-5).

In addition to the systematic sampling locations discussed above, four targeted samples will be collected. The targeted locations were selected based on existing data of the four highest chromium values found during previous sampling activities of the IWD. These locations are 0.0, 0.4, 1.4, and 1.6 miles from the IWD outfall and are shown in Figures A-2-2, A-2-3, and A-2-4 at locations as close as possible to the original sample locations. All sampling locations will be referenced from the survey posts that will be installed in the IWD as discussed in FSP Section 3.8 and the Data Management Plan (DMP) using a compass and tape.

2.2.1 Sample Collection

Surface and sediment "undisturbed" soil samples will be taken with a stainless steel split barrel sampler using a modified American Standards for Testing Materials (ASTM) method 1586D (SOP-SC-02 - Appendix E). This method involves using a clean, decontaminated (SOP-DC-16) stainless steel split barrel spoon sampler to collect the upper 12 inches of soil. SOP-SC-02 and Sample Data Sheets 1, 2, 5, 15, 17, 27, 29, 35 and 63 will be used to collect and submit surface and sediment samples to the analytical laboratory for chemical analysis.

Seventy three surface and sediment samples will be collected; 34 samples will be collected in the first segment of the IWD, 17 will be collected in the second segment, nine will be collected in the third segment, nine in the fourth segment, and four targeted locations along the IWD. Table A-2-1 provides a list of the chemical analyses for samples collected for Part A of the FSP.

The following is a summary of the types of QA/QC samples and the required analyses that will be performed for this sampling effort. Table A-2-1 shows the number of QA/QC samples for each sampling entity for Part A of the FSP. All QA/QC samples will be performed in accordance with the appropriate SDSs and SOPs. All field duplicate samples will be "blind samples"; undistinguishable from other samples. One equipment rinsate sample will be collected for every 20 surface sediment samples. The rinsate sample will be analyzed for selected Total Metals along with VOCs and SVOCs, with results reported in Contract Laboratory Program (CLP) format (see Table A-2-1). One duplicate sample will be collected for every 20 surface sediment samples. The duplicate sample will be analyzed for the same parameters as the original sample. One field blank for every 20 samples will be prepared using previously analyzed and certified sand and shipped with the sample. Certified sand is sand that has been previously analyzed by an analytical laboratory for which certified results are available. The results from the field blanks will be compared to the previous certified results. The sand field blank will be used to better simulate actual soil adsorption of mobile contaminants.

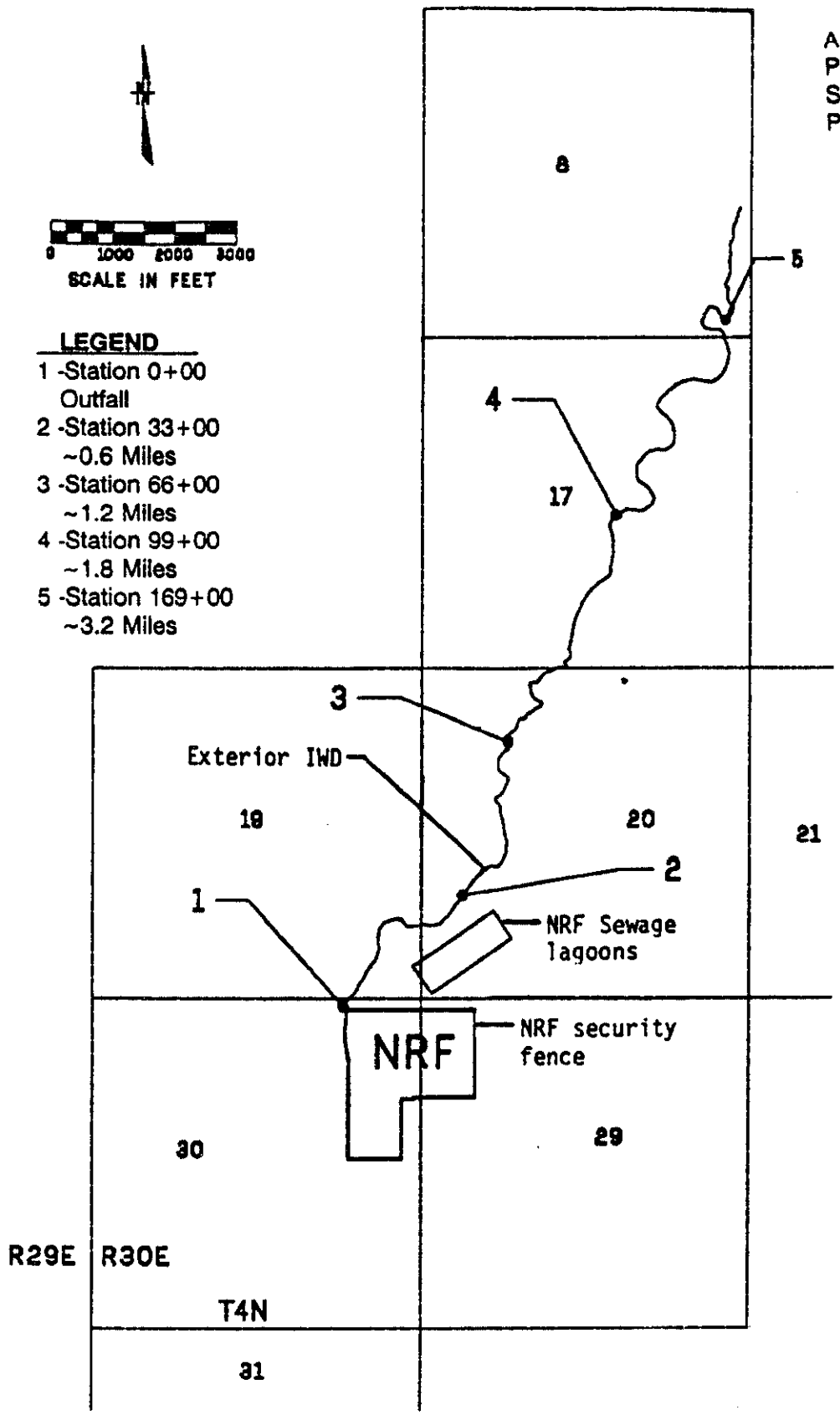

Figure A-2-1 NRF IWD Station Locations

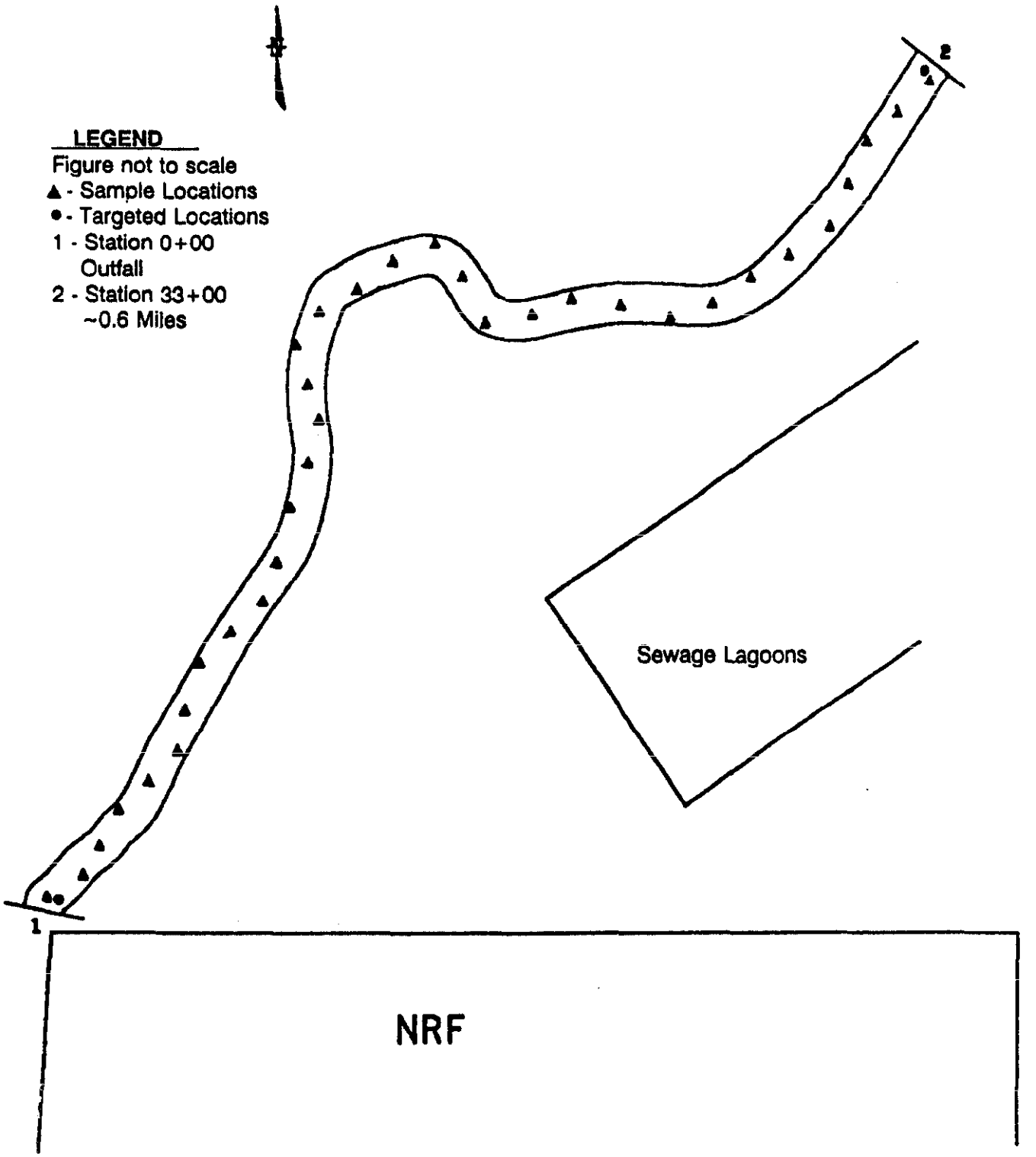

Figure A-2-2 Sample Locations Outfall to 0.6 Miles

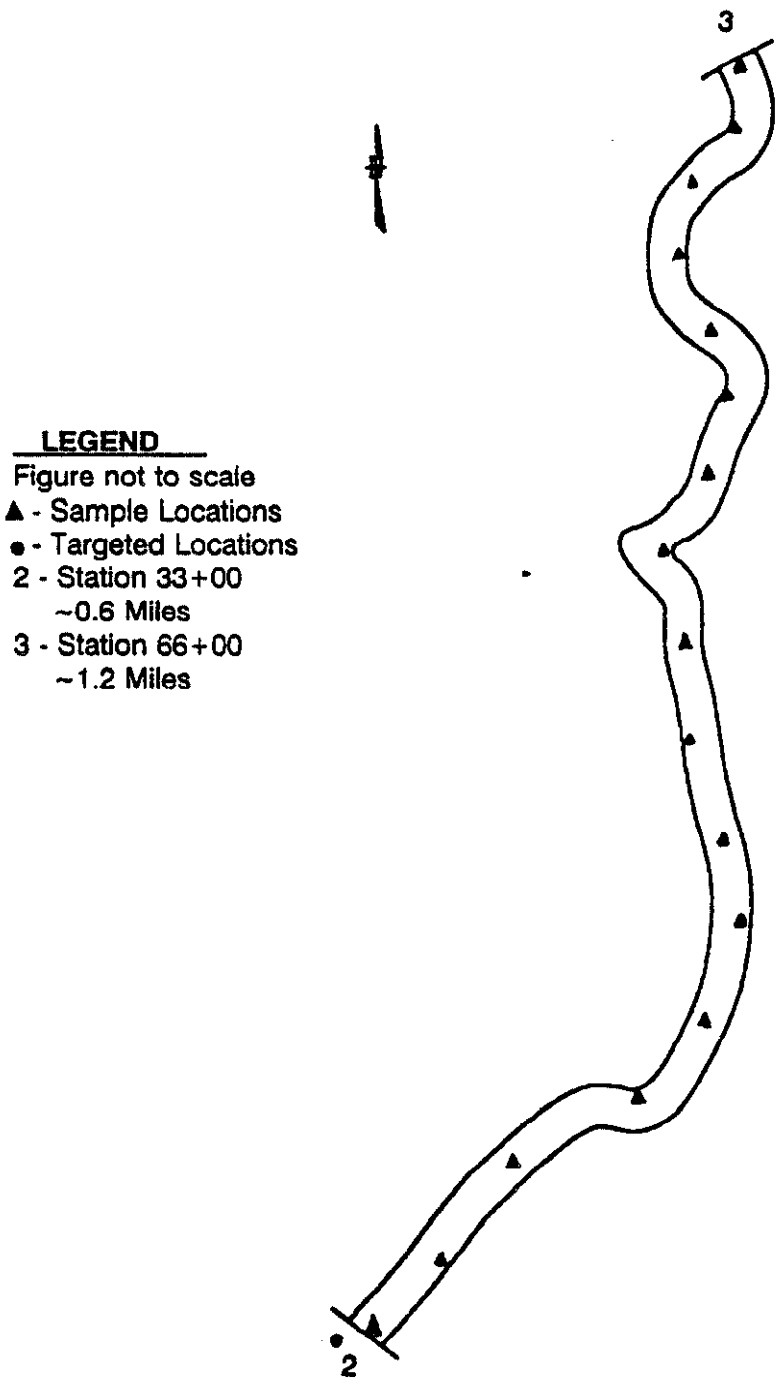

Figure A-2-3 Sample Locations - 0.6 Miles to 1.2 Miles

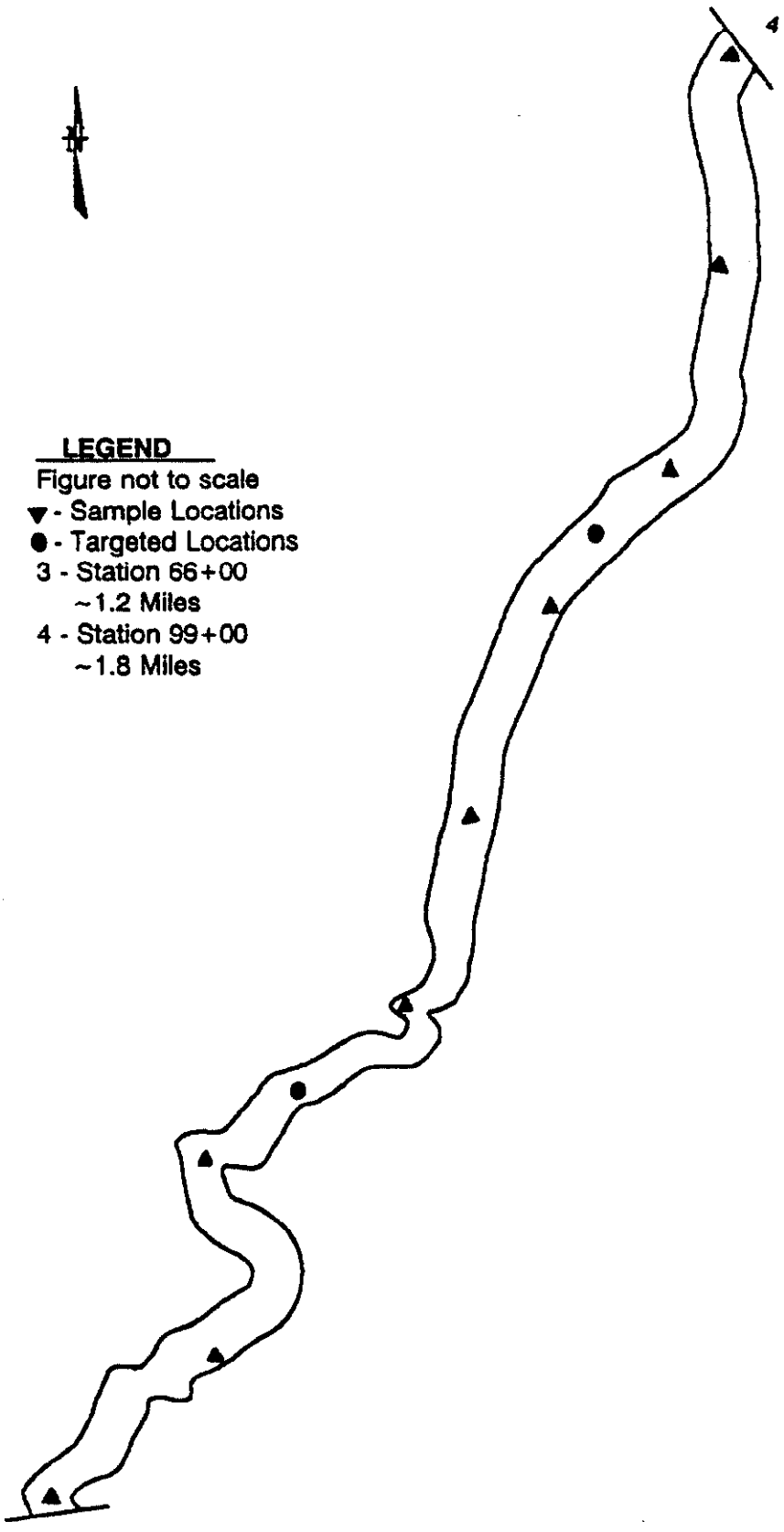

Figure A-2-4 Sample Locations - 1.2 Miles to 1.8 Miles

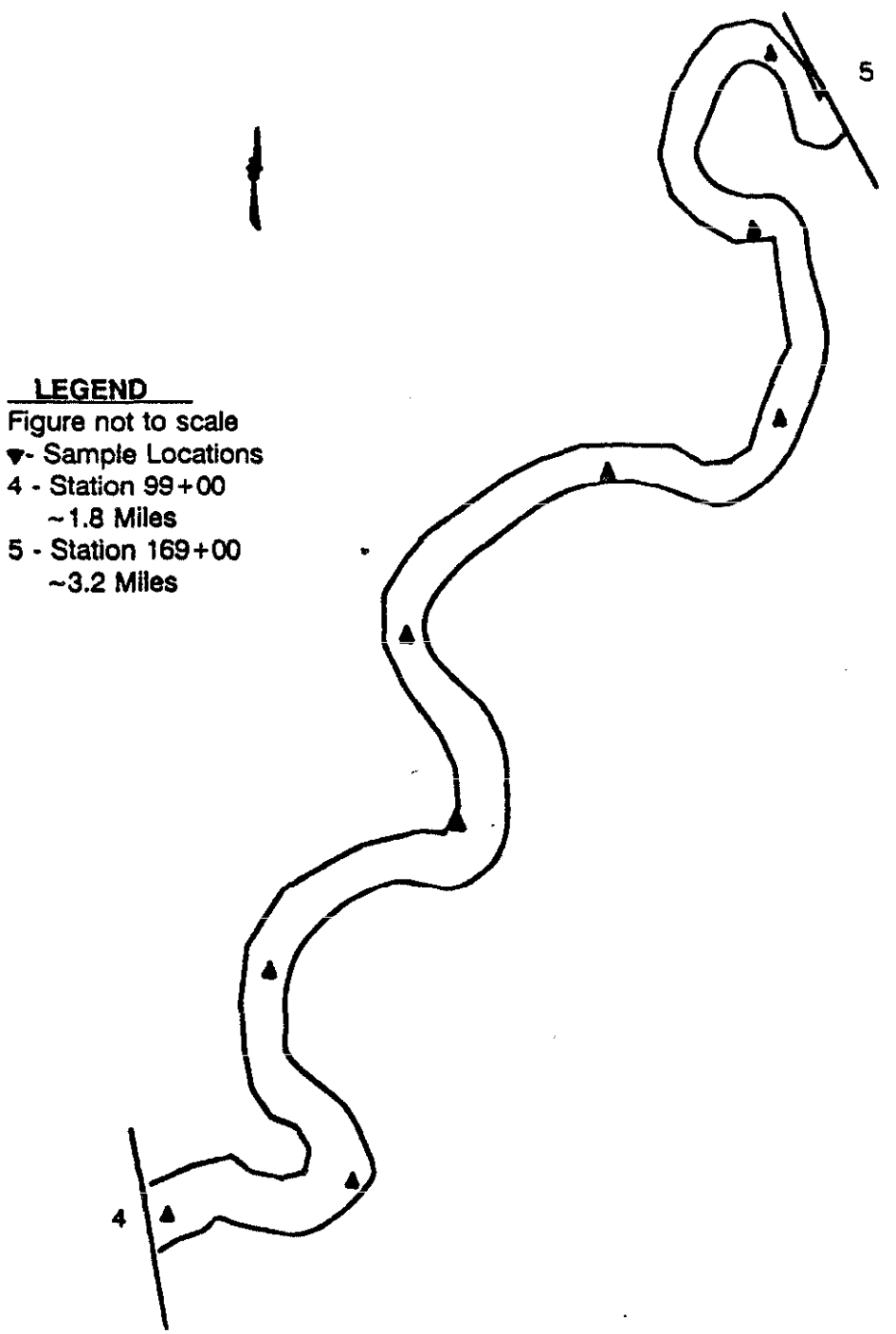

Figure A-2-5 Sample Locations - 1.8 Miles to 3.2 Miles

The field blanks will be analyzed for the same analytes as the soil samples. One trip blank will accompany each sample cooler that contains samples to be analyzed for VOCs. The trip blank will consist of an unopened 40-ml vial filled with distilled, deionized water provided by the laboratory. If the laboratory receives more than one cooler of samples in a shipment, they will select one trip blank per shipment and analyze it for VOCs. If VOCs are found in the trip blank, the remaining trip blanks from that shipment will be analyzed for VOCs.

2.2.2 Chemical Analysis and Physical Property Testing

All soil samples from Part A of the FSP will be submitted for chemical analyses and physical property tests listed in Table A-2-1 and Table A-2-2. SOP-SC-02 also contains additional procedures to be used when sample recovery is insufficient using the stainless steel split barrel sampler; for example, in locations where the top of the basalt is exposed at the bottom of the IWD. As shown on Table A-2-1, Toxicity Characteristic Leaching Procedure (TCLP) analysis for selected metals will be performed on all selected Total Metal samples that have a metal analysis result of 20 or more times higher than the TCLP limit for that analyte; however, the number of TCLP Metal analyses performed will not exceed 50% of the total number of samples.

2.3 Dredge Soil Piles Investigation

The dredge soil piles samples will be collected by taking samples; on the surface of the dredge piles, within the dredge piles, and beneath the piles. A typical cross-sectional view of a dredge pile showing the relative location of the three types of samples is shown in Figure A-2-6. The dredge pile sampling will be conducted using a tiered approach similar to that of the IWD sediment sampling. The dredge soil piles will be divided into two tiers; the first tier from station 00+00 to 33+00, and the second tier from station 33+00 to 66+00. The dredge piles end at station 70+00, and only a surface sample will be collected after station 66+00.

A total of seven surface samples will be collected over the entire length of the dredge piles. A total of 51 interior dredge soil pile samples will be collected over the two tiers, 34 samples will be collected in the first tier and 17 in the second. A total of 51 below dredge soil pile samples will be collected over the two tiers, 34 samples will be collected in the first tier and 17 in the second. Table A-2-1 provides a list of the chemical analyses for the samples collected for Part A of the FSP. Sections 2.3.1 and 2.3.2 contain a more detailed description of the dredge soil pile investigation.

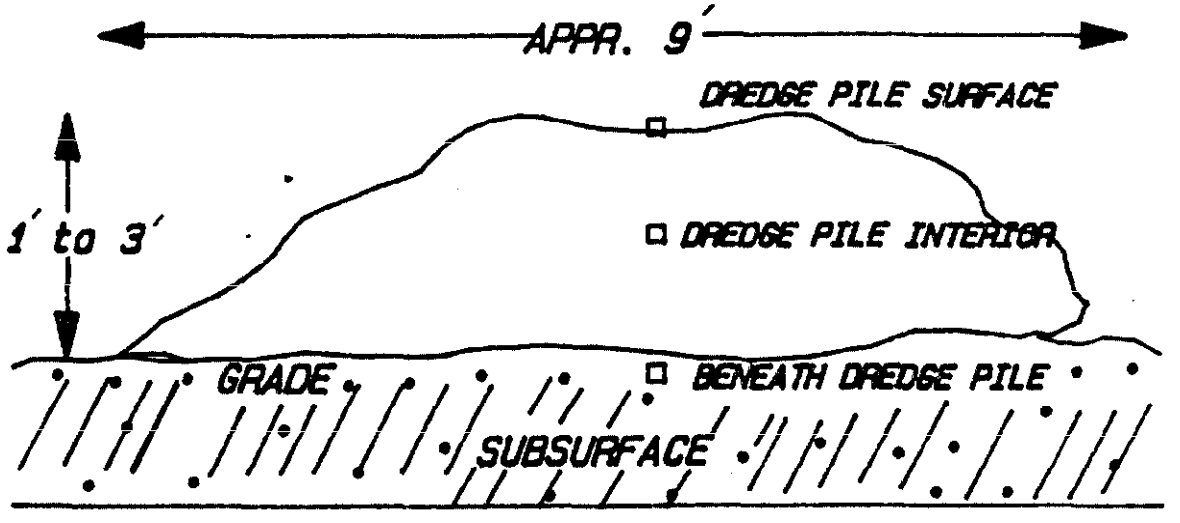

Figure Not To Scale

Figure A-2-6 Cross-section of Dredge Soil Pile

2.3.1 Soil Sampling

2.3.1.1 Surface Soil Samples

Surface soil sampling of the dredge soil piles along the banks of the IWD will be grab samples in accordance with NRF SOP-SC-01 and Sample Data Sheets 1, 5, 7, 23, 27, 31, 35, and 63 (see Appendix E, Standard Operating Procedures and Sampling Techniques).

A surface sample will be collected every 1000 feet downstream along the IWD, starting at the outfall. Each sample will be collected at the approximate center of the pile.

The sampling locations may be adjusted to fit dredge soil pile conditions and the lack of continuity of the piles. All sampling will be referenced to the survey posts installed in the IWD. The location of the sample will be identified on the sampling map and recorded in the Field Logbook.

2.3.1.2 Interior Pile Samples

Soil samples will be collected from the interior of the dredge piles using a stainless steel bucket auger or split barrel sampler that has been decontaminated in accordance with SOP-DC-16. Beginning at a point at the center of the pile, the auger will be advanced to the depth of the approximate mid-height of the pile. A grab sample will be obtained from the bucket auger for appropriate collection into sample containers as described in NRF SOP-SC-01 or SOP-SC-02 and Sample Data Sheets 1, 5, 7, 23, 27, 31, 35, and 63 (see Appendix E, SOPs and Sampling Techniques).

The dredge soil piles will be sampled in segments as discussed in Section 2.2 for sediment sampling. From station 00+00 to station 33+00, Interior Pile Samples will be collected every 100 feet. From station 33+00 to station 66+00, Interior Pile Samples will be collected every 200 feet. From station 66+00 to the end of the dredge piles (approximately 70+00), no samples will be collected. Interior Pile Samples will be collected from locations which alternate from one side of the channel to the other as sampling continues downstream along the IWD, starting at the outfall. Sampling locations may be adjusted to fit pile conditions and the lack of continuity of the piles.

2.3.1.3 Beneath Pile Samples

Soil samples from approximately one foot beneath the base of the piles will be collected using a stainless steel bucket auger that has been decontaminated in accordance with SOP-DC-16. The auger will be advanced to approximately one foot beneath the pile base, beginning at a point at the center of the pile. A grab sample will be obtained from the bucket auger for appropriate collection into sample containers as described in NRF SOP-SC-01 and Sample Data Sheets 1, 5, 7, 23, 27, 31, 35, and 63 (see Appendix E, Standard Operating Procedures and Sampling Techniques).

Beneath Pile Samples will be collected at the same sampling locations and frequencies as the Interior Pile Samples (see Section 2.3.1.2). Sampling locations may be adjusted to fit pile conditions and the lack of continuity of the piles.

A total of 109 dredge pile soil samples will be collected; seven surface samples, 51 Interior Pile Samples and 51 Beneath Pile Samples.

The following is a summary of the types of QA/QC samples and the required analyses that will be performed for this sampling effort. Table A-2-1 shows the number of QA/QC samples for each sampling entity for Part A of the FSP. All QA/QC samples will be conducted in accordance with the appropriate SDSs and SOPs. All field duplicate samples will be "blind samples" undistinguishable from other samples. One equipment rinsate sample will be collected for every 20 surface sediment samples. The rinsate sample will be analyzed for selected Total Metals, VOCs, and SVOCs, with results reported in Contract Laboratory Program (CLP) format (see Table A-2-1). One duplicate sample will be collected for every 20 surface sediment samples. The duplicate sample will be analyzed for the same parameters as the original sample. One field blank will be prepared for every 20 samples using previously analyzed and certified sand and shipped with the sample. Certified sand is sand that has been previously analyzed by an analytical laboratory for which certified results are available. The results from the field blanks will be compared to the previous certified results. The sand field blanks will be used to better simulate actual soil adsorption of mobile contaminants. The field blanks will be analyzed for the same analytes as the soil samples. One trip blank will accompany each sample cooler that contains samples to be analyzed for VOCs. The trip blank will consist of an unopened 40-ml vial filled

with distilled, deionized water provided by the laboratory. If the laboratory receives more than one cooler of samples in a shipment, they will select one trip blank per shipment and analyze it for VOCs. If VOCs are found in the trip blank, the remaining trip blanks from that shipment will be analyzed for VOCs.

2.3.2 Chemical Analysis and Physical Property Testing

All soil samples from Part A of the FSP will be submitted for chemical analyses and physical property tests listed in Table A-2-1 and Table A-2-2. SOP-SC-02 contains additional procedures to be used when sample recovery is insufficient using the stainless steel split barrel sampler; for example, in locations where the top of the basalt is exposed at the bottom of the IWD. VOC analysis will be performed on 25% of all Interior and Beneath Pile samples, but not on Surface Soil Samples. Toxicity Characteristic Leaching Procedure (TCLP) analysis for selected metals will be performed on all selected Total Metal samples that have a metal analysis result of 20 or more times higher than the TCLP limit for that analyte; however, the number of TCLP Metal analyses performed will not exceed 50% of the total number of samples.

2.4 Background Samples

Thirty background surface soil samples will be collected at twenty sample locations in accordance with SOP-SC-01 and Sample Data Sheet No. 1. The locations of these samples were determined based on identification of undisturbed soils near the IWD, review of aerial photographs, wind rose direction, location of INEL facilities, and a literature search of other background data at the INEL. The locations selected have soil conditions as close to the IWD soil conditions as possible. Figure A-2-7 shows the tentative locations of the background sample locations. These locations may change slightly if problems are encountered during sampling, or if there is evidence that they do not represent undisturbed soil.

One sample will be collected and analyzed for selected Total Metals and TCLP Metals at each location as indicated in Table A-2-1. Five background soil samples will be collected at five of the twenty locations and analyzed for Total Petroleum Hydrocarbons (TPH) and SVOC analysis as indicated in Table A-2-1. See Section 4.3.4 of the Work Plan for sample and analysis rationale. One equipment rinsate sample and one replicate sample will be analyzed for Total Metals as a QC check on the background samples. Trip blanks will accompany all shipments and will be analyzed as discussed in Sections 2.2.1 and 2.3.1.3.

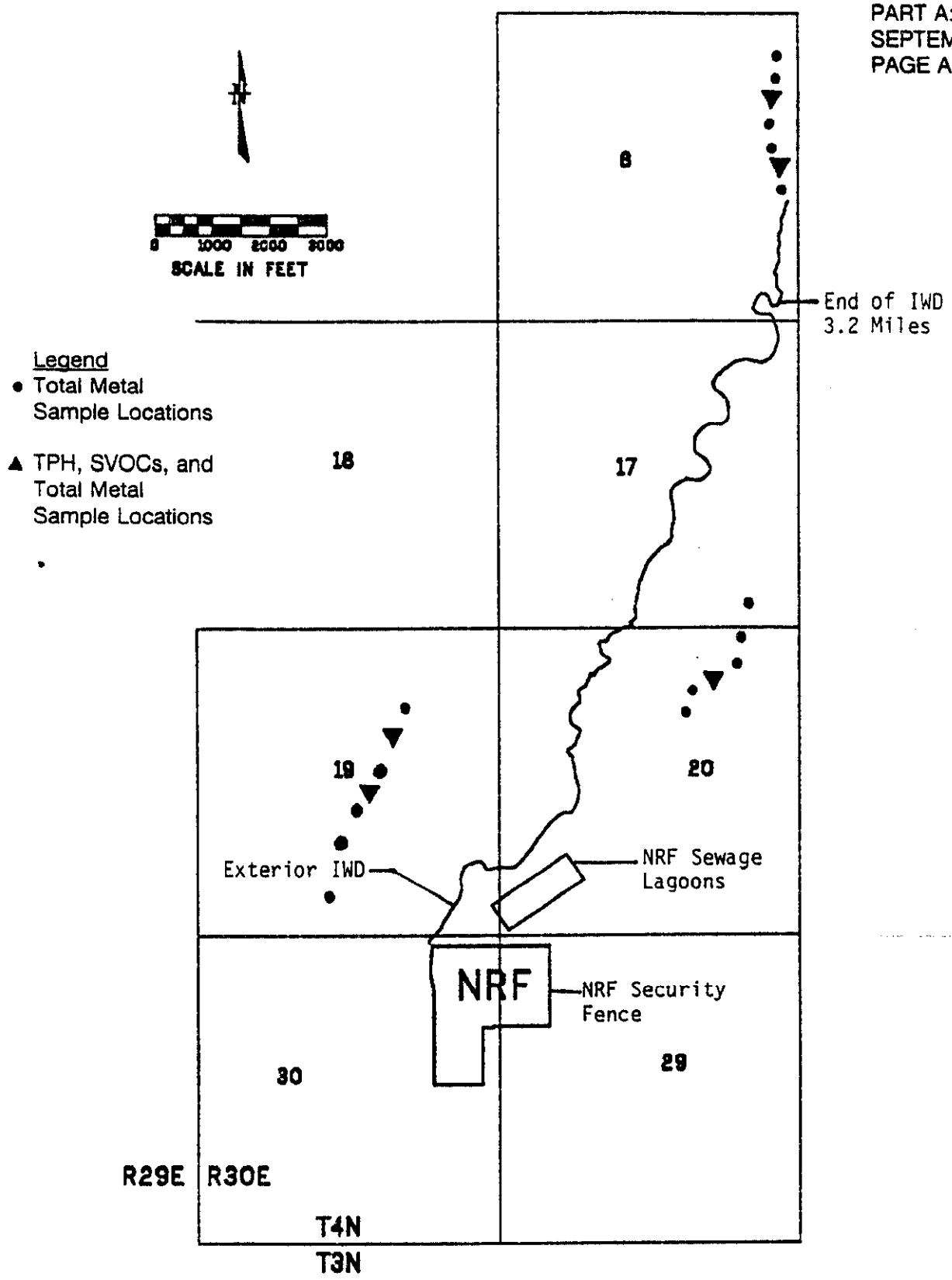

Figure A-2-7 Tentative Locations of Background Samples

Table A-2-1 IWD Field Sampling Plan Chemical Analyses for Soil Samples

SOIL SAMPLE LOCATION	WESTINGHOUSE FURNISHED LABORATORY ANALYSIS						SELLER PROVIDED ANALYSIS	
	VOCs	SVOCs	SELECTED TOTAL METALS	SELECTED TCLP METALS	TPH	QA/QC SAMPLES	PHYSICAL PARAMETERS	SAMPLE DEPTH
IWD SURFACE SEDIMENT SAMPLES STATION 0+00 TO 33+00	34	34	34	X	7	17	8	≤1'
IWD SURFACE SEDIMENT SAMPLES STATION 33+00 TO 66+00	17	17	17	X		8		≤1'
IWD SURFACE SEDIMENT SAMPLES STATION 66+00 TO 99+00	9	9	9	X		5		≤1'
IWD SURFACE SEDIMENT SAMPLES STATION 99+00 TO 159+00	9	9	9	X		5		≤1'
TARGETED SAMPLES			4	X		1		≤1'
DREDGE PILES SURFACE			7	X		2		SURF.
DREDGE PILES INTERIOR STATION 0+00 TO 33+00	8	8	34	X		7	4	≤2'
DREDGE PILES INTERIOR STATION 33+00 TO 66+00	4	4	17	X		5	2	≤2'
BENEATH DREDGE PILES STATION 0+00 TO 33+00	8	8	34	X		7	4	≤4'
BENEATH DREDGE PILES STATION 33+00 TO 66+00	4	4	17	X		5	2	≤4'
BACKGROUND		5	20	X	5	7		≤1'
TOTALS	93	98	202	X	12	69	18	

VOCs and SVOCs using methods selected from Exhibit D of CLP SOW OLM01.0 - Organics.

Methods for selected Total Metals using methods from Exhibit D of CLP SOW OLM01.0 - Inorganics shown in Table A-2-2.

X - Selected TCLP Metals analysis will be performed on each sample that exhibits a Total Metals Analysis result that is 20 or more times higher than the TCLP limit. TCLP analysis will not be performed on greater than 50% of all samples for each category.

Table A-2-2 IWD Field Sampling Plan Analyses for Soil Sampling Chemical and Physical Parameters

PARAMETER	METHOD	*EPA DQL	RATIONALE
MERCURY***	245.1-M	IV	1,5
CHROMIUM (HEXAVALENT AND TOTAL)***	218.2-M	IV	1
LEAD***	239.2-M	IV	1
SILVER***	200.7-M	IV	1
BARIUM***	200.7-M	IV	2
COPPER***	200.7-M	IV	2
NICKEL***	200.7-M	IV	2
ZINC***	200.7-M	IV	2
VOCs	624-M	IV	1,5
SVOCs	625-M	IV	1,5
TOTAL PETROLEUM HYDROCARBONS (TPH)	418.1	III	3
SOIL PARTICLE SIZE (INCLUDES PM-10)**	X	III	3,4
CATION EXCHANGE CAPACITY**	X	III	3
SOIL TRANSMISSIVITY**	X	III	3
K_d - DISTRIBUTION COEFFICIENT**	ASTM D	III	3
SOIL PERMEABILITY**	X	III	3
SOIL REDUCTION-OXIDATION**	X	III	3
SOIL pH**	X	II	3
SOIL BUFFERING CAPACITY**	X	III	3
SOIL PARTICLE DENSITY**	X	III	3,4

* For definition of Data Quality Levels, see QAPjP Section 1.5
** Physical Parameter
*** Selected Metals
1 known process release
2 background indicator
3 fate, transport and CSM evaluation
4 airborne fraction (dust) evaluation
5 characterization
X TBD by Contractor
-M Modified methods specified in CLP SOW

3.0 HYDROGEOLOGICAL INVESTIGATION

3.1 Objectives and Data Needs

The NRF hydrogeological investigation has two main objectives: to demonstrate the presence or absence of chemical contaminants in the ground water and alluvium beneath the IWD; and to gather data necessary to evaluate contaminant fate and transport in the soil to support the risk assessment. Other tasks that will be achieved during the completion of the two main objectives are data collection to support remedial action alternative evaluation, to refine the conceptual site model, and to provide data for future potential ground water modeling efforts.

Some data needed to achieve the above objectives are presently available. However, data gaps still exist. These include inadequate or unvalidated samples, lack of physical parameter information, and incomplete subsurface hydrogeological characterization. Because of the uncertainties associated with any geological investigation, much of the work proposed in this Field Sampling Plan will be conducted using a phased approach. This will entail collection and interpretation of data prior to executing the next phase. Major work items that will be included in this phased approach are: collection of resistivity data discussed in Section 3.3.2 prior to drilling the wells discussed in Section 3.4.2; performing the infiltration study discussed in Section 3.5 prior to the final selection of the locations for the cross-sectional borings along the IWD discussed in Section 3.4.1; and collection and analysis of physical parameters samples from the outfall cross-sectional borings prior to the collection of samples from other holes. The following sections discuss elements of the proposed hydrogeological investigation.

3.2 Activity Summary

The following is a description of the hydrogeological data collection effort which will be performed under the RI/FS.

- Geophysical Investigation
  - Gravimetric Survey
  - Resistivity Survey
- Alluvium Characterization
- Surface Samples
  - Permeability, redox, pH, buffering capacity (BC), Cation Exchange Capacity (CEC), Soluble Ion Exchange Capacity (SIEC), Distribution Coefficient (K_d), clay mineralogy, particle size distribution

- Deep Samples
  pH, CEC, particle size distribution, organics, and metals distribution

- Perched Water Investigation
  Construct shallow wells
  Conduct pump tests on wet perched water wells (new wells)
  Sample perched water wells (new wells)
  Perform perched water slug tests (existing wells)
  Perform IWD infiltration study
  Measure process discharges to IWD
  Measure level of perched water

- Survey IWD
  Create detailed cross-sections of IWD
  Place distance markers along IWD

- Geochemical Sampling of Perched Water, IWD, and Sewage Lagoons
  Anions, cations, nutrients, organics, and metals

3.3 Geophysical Investigation

3.3.1 Gravimetric Profiling

Early in the RI/FS sampling project, a gravity survey will be performed. A microgravimeter will be used, in accordance with SOP-IO-13, to better define features of the basalt surface surrounding the IWD. A gravity station spacing interval of 100 feet will be used to assure that the true size of topographic highs and lows occurring in the surface of the basalt are accurately recorded.

Well site NRF-7 will be used as the primary base station. Secondary base stations will be used as necessary. Readings used to make diurnal corrections will be collected at the base stations every two to three hours. Additional data reduction corrections will include latitude corrections, free-air corrections, and Bouguer corrections. Terrain corrections and corrections for deep regional gravity trends will be made as required.

Figure A-3-1 shows the location of profile lines and gravity stations that will be used during this survey. Readings will be gathered along 19 lines at approximately 600 station locations. Stations will be located using a Brunton compass and a Hip-Chain, as well as a survey transit. Elevation and the exact location of the gravity stations will then be determined using standard surveying methods.

Twenty-five holes will be bored to the top of basalt at the approximate locations shown in Figure A-3-3. These bore holes will be used to accurately measure the depth to bed rock at specific locations. The data will then aid in the interpretation of the data obtained from the gravimetric survey.

3.3.2 Resistivity Sounding and Profiling

The resistivity work will be performed in two phases. First, a resistivity sounding will be performed over the perched water body located beneath wells PS-1, 5, 7 and 9 (see Figure A-3-2). The purpose of sounding will be to determine the electrode spacing necessary to penetrate to the depth of the perched water. The depth of penetration increases as the electrode spacing increases. At some point, a noticeable change in resistivity readings should occur. This change corresponds to the effect of increased conductivity due to perched water. Once this optimum spacing has been determined, resistivity profiles will be run laterally along lines which cross the suspected boundaries of known perched water zones.

Ideally, a unique signature will be seen that correlates to passage over the perched water body. If successful, additional work will be performed in areas of the IWD where perched water is suspected to be present. If resistivity measurements indicate the presence of additional perched water, a maximum of five wells may be drilled to confirm these findings. Construction specifications for these wells are contained in SOP-DR-21.

Both sounding and profiling will be performed using the Werner and Schlumberger arrays in accordance with SOP-IO-14. The results of each method will be compared, and the most successful approach will be chosen for perched water exploration (See Work Plan Section 4).

3.4 Geological Investigation

3.4.1 Alluvium Characterization

Twenty-eight shallow bore holes will be drilled in the vicinity of the IWD. The primary purposes for drilling these bore holes is to assess the stratigraphic characteristics of the alluvium in which the IWD is imbedded and to evaluate the spread of contaminants from the IWD sediments into the alluvium. Samples will be collected at various depths in these bore holes for both physical and chemical analyses.

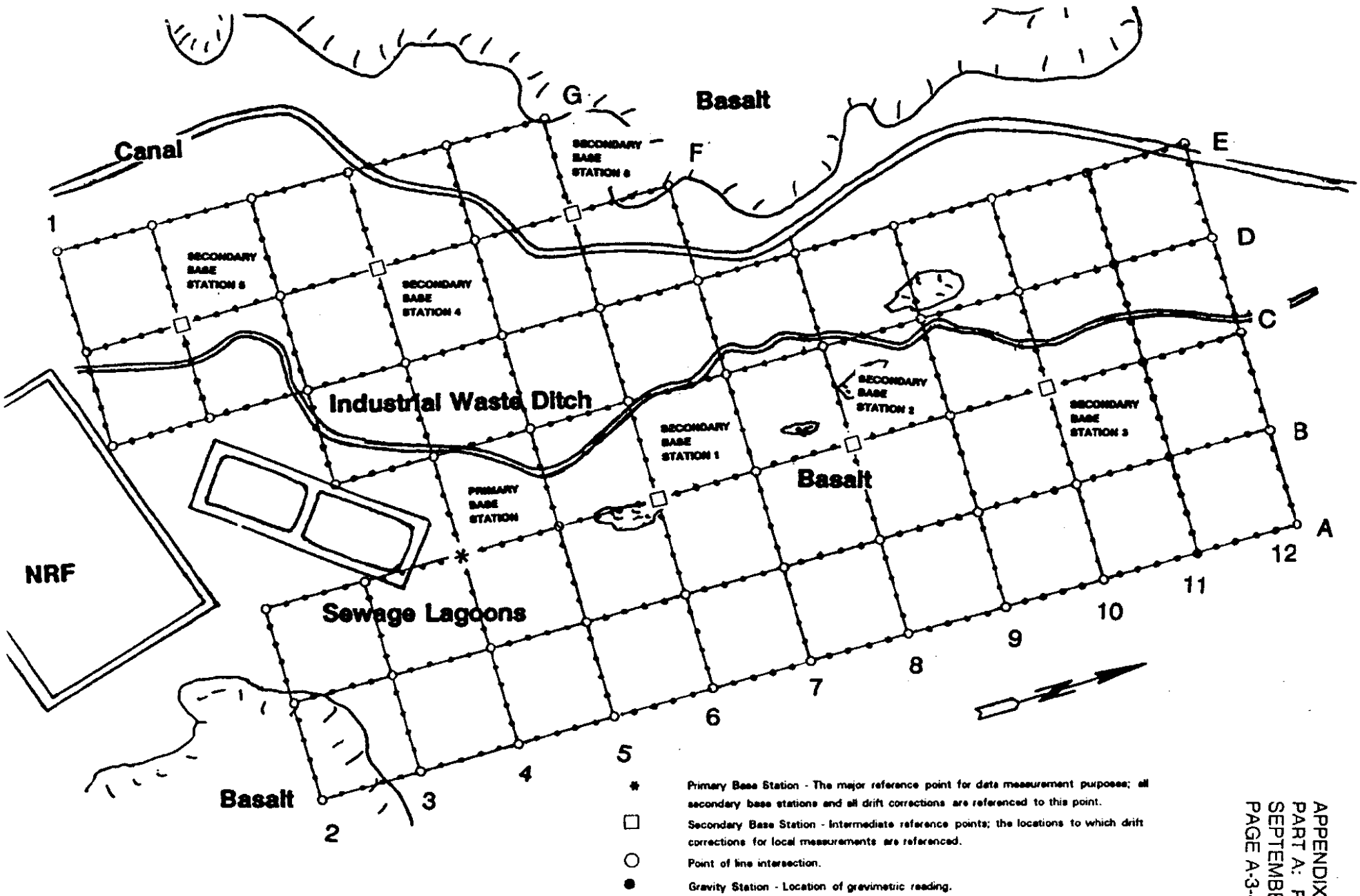

Figure A-3-1 Gravity Station and Base Location Map

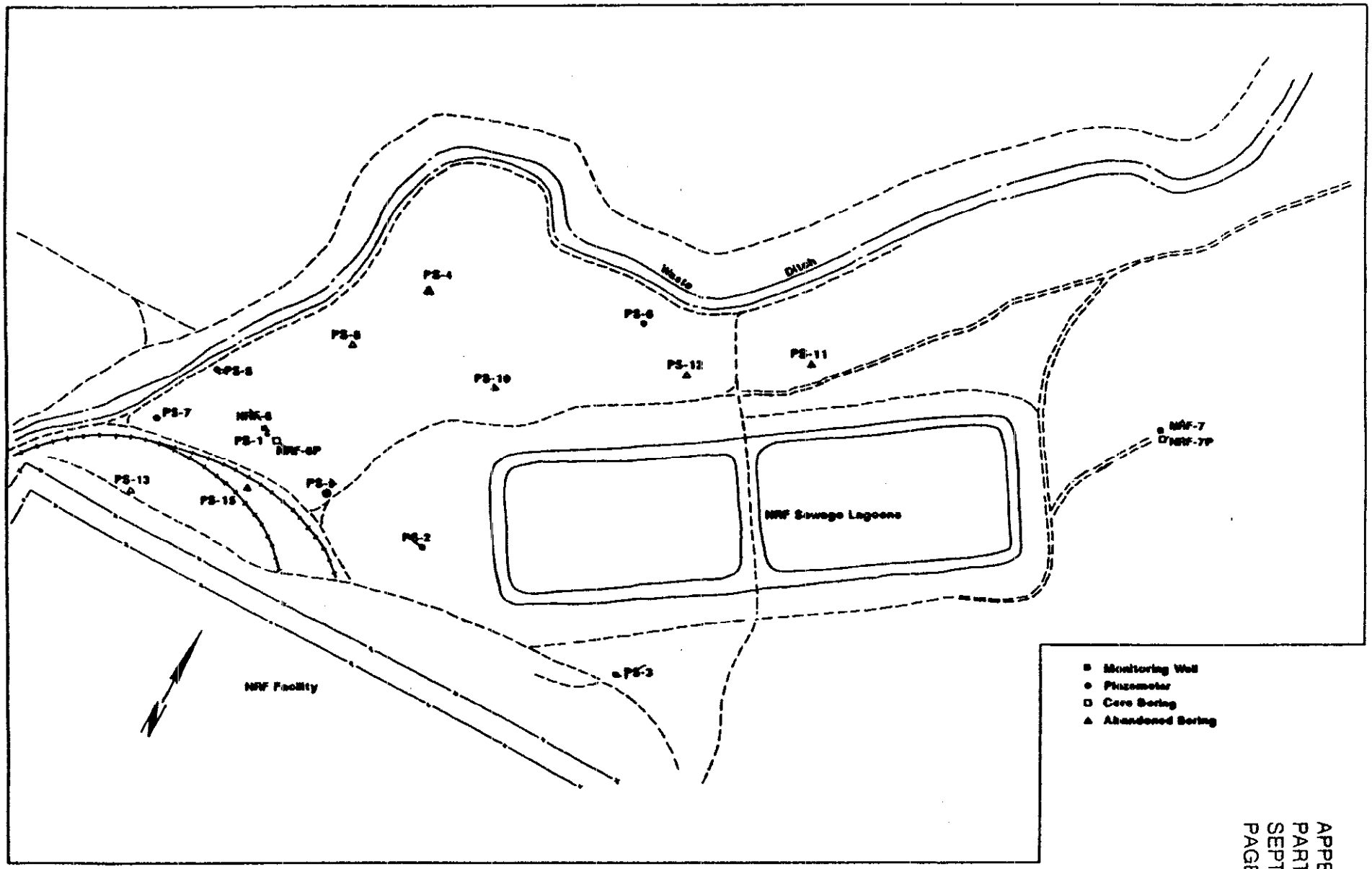

Figure A-3-2 Perched Water Body Beneath Wells PS1, 5, 7, and 9

The 28 bore holes will be augered along cross-sectional lines discussed below (see Figure A-3-3). The stratigraphy of each hole will be described from cuttings. The presence of clay lenses or any moisture will be specifically noted. Special attention will be given to accurately determine the depth to bedrock. Depth to bedrock is expected to be 10 to 50 feet. All holes will be terminated at the top of basalt. Auger cuttings will be dispositioned in accordance with SOP-WM-24.

Figure A-3-3 shows the tentative location of four lines which intersect the IWD at right angles. Seven auger holes will be drilled along the trace of each of these lines. Two holes will be drilled 50 feet from the center of the IWD, one on each side. Two holes will be drilled 10 feet on either side of the IWD. Two more holes will be drilled approximately two feet from the banks of the IWD. The last hole will be drilled through the center of the IWD. These holes will be drilled with a hollow stem auger to the surface of bedrock, and samples will be collected using a split-spoon sampler in accordance with SOP-SC-2.

Extensive testing for physical parameters will be performed on samples extracted from the bore holes at 0 and 2 feet on the cross-section located at 0.6 miles from the outfall. Samples from bore holes at 0 and 2 feet from the other cross-sections will be analyzed for physical properties as needed based on changes in physical characteristics. This determination will be made by the field engineer on location. The following paragraphs discuss the physical and chemical analyses that will be performed on samples collected at 0.6 miles from the outfall.

3.4.1.1 Bore Holes at 50 Feet

Two samples in each of the distal holes will be extracted from the alluvium two feet below the bottom of the surface loess. Additionally, samples will be extracted each ten feet until bedrock is encountered. Grain size distribution will be determined for these samples.

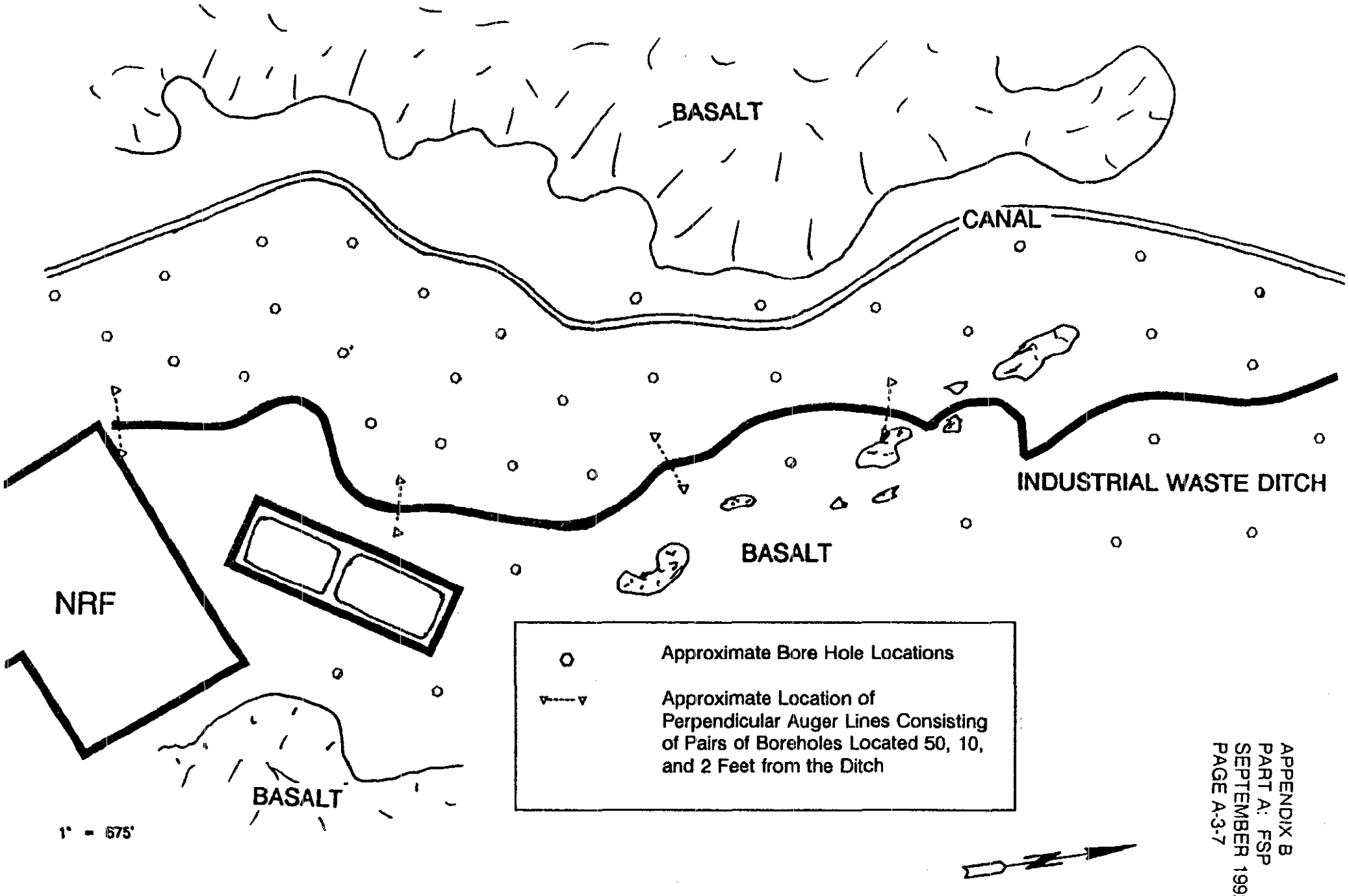

Figure A-3-3 Tentative Auger Hole Locations

3.4.1.2 Bore Holes at 10 Feet

Samples from the auger holes located ten feet from the IWD will be analyzed for both physical and chemical parameters. Applicable SOPs and ASTM procedures will be observed. The exact number of each type of sample will depend on the depth to the top of basalt at that location as described below.

A sample from each of the holes at ten feet will be taken from zero to six inches below land surface (bls). These samples will be analyzed in accordance with ASTM procedures using an x-ray diffractometer. The mineralogy and relative quantity of each type of clay will be determined. This soil will also be analyzed in accordance with applicable ASTM procedures for CEC, buffering capacity, and grain size distribution. An unsieved sample will also be analyzed. This sample will also be analyzed for total metals. If the total metal analysis results are 20 times higher than the TCLP limits, a six inch core of the surface loess will be extracted near one of the ten foot holes. The saturated porosity and permeability of the core will be determined. The results from these analyses will be compared to the results from analyses of samples from the IWD channel.

Samples of the alluvium will be collected from both sides of the IWD, at depths of two feet below ditch static water level (bswl) and then every 10 feet thereafter until bedrock is encountered. A grain size distribution will be determined for these samples using ASTM procedures. Additionally, bulk samples of the alluvium will be collected at the same depths and analyzed for chemical parameters. These samples will be sieved in accordance with SOP-SC-11. Those particles which pass through the mesh will be collected and analyzed for Total Metals. One sample collected from each hole at 12.0 feet bswl will be analyzed for TCLP Metals if the sample analyzed for Total Metals exceeds a threshold value of 20 times greater than the TCLP limit (See Table A-3-1 and Table A-3-4).

Table A-3-1 Proposed Analyses in Bore Holes at 10 Feet from the IWD Bank

Proposed Analyses	Depth in Feet Below Static Water Level		
	0 to .5	2, +10 UBR	12
Grain Size Distribution	YES	YES	
Physical Characteristics	YES		
Total Metals - Sieved		YES	
TCLP Metals - Sieved[X]			YES
Total Metals - Unsieved	Yes		
TCLP Metals - Unsieved	Yes		

UBR = until bedrock is reached

[X] Selected TCLP METALS analysis will be performed on each sample that exhibits a Total Metals Analysis result that is 20 or more times higher than the TCLP limits up to a limit of 5 percent of Total Metal samples.

3.4.1.3 Bore Holes at 2 Feet

Two auger holes will be drilled on either side of the IWD, two feet laterally from the approximate static water level line in the IWD channel to determine whether zonation of potential contaminants has occurred (see Work Plan Section 4). Samples for chemical analysis will be collected from these holes. The first sample will be taken from a point six inches below the surface. The next samples will be taken at 1.5, 2.0, 3.0, 4.0, 5.0, 6.5, 8.0, 10.0, 12.0, and 15.0 feet bswl, respectively.

Additional samples will then be taken every 10 feet until bedrock is encountered. One sample from each side of the IWD will be collected from the surface half-way between the static water level and the auger hole. This sample will consist of a composite of material from 0" to 6" below land surface. These samples will be analyzed for Total Metals and TCLP Metals if the analysis for Total Metals exceeds 20 times greater than the TCLP limits (See Table A-3-2 and Table A-3-4).

Table A-3-2 Proposed Analyses in Cross-section Bore Holes at 2 Feet from IWD Bank

Proposed Analyses	Depth in Feet Below Static Water Level										
	.5	1.5	2.0	3.0	4.0	5.0	6.5	8.0	10.0	12.0	15.0, +10 UBR
Grain Size Distribution	*	*	*	*	*	*	*	*	*	*	*
Distribution Coefficient for Cr, Pb, Ag, Hg, Fe, Mg, Mn	*	*	*	*	*	*	*	*	*	*	*
Physical Characteristics	*	*	*	*	*	*	*	*	*	*	*
Total Metals - Unsieved	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Total Metals - Sieved		YES		YES		YES					
Total Metals - Gravel and Sand Rinsate		YES		YES		YES					
TCLP Metals - Sieved[X]	X	X	X	X	X	X	X	X	X	X	X
TCLP Metals - Unsieved[X]	X	X	X	X	X	X	X	X	X	X	X
TCLP SVOCs Sieved					YES					YES	
TCLP VOCs and SVOCs Unsieved					YES						

UBR = until bedrock is reached

*The number and depth of samples will be determined by the Project Engineer

[X] Selected TCLP Metals analysis will be performed on each sample that exhibits a Total Metals Analysis result that is 20 or more times higher than TCLP limits

Samples collected on 10 foot intervals below 15 feet will be analyzed for Total Metals and will be unsieved. The samples collected from these depths will also be analyzed for TCLP Metals if analysis results of Total Metals samples exceed 20 times greater than the TCLP limits up to a maximum of 50 percent of the number of total metal samples. Samples from 2.0, 4.0 and 12.0 feet bswl will also be analyzed for TCLP SVOCs. Each of the samples will be prepared for analysis in accordance with SOP-SC-11 (Sieving).

Sieved sand and gravel samples prepared in accordance with SOP-SC-11 will be collected from 1.5, 3.0, and 5.0 feet bswl. These samples will be analyzed for Total Metals, and TCLP Metals will be analyzed only if the threshold values described above are exceeded. The portion of the samples collected at 1.5, 3.0 and 5.0 feet bswl not passing through the sieve will be prepared for analysis in accordance with SOP-SC-12 (Acid Rinse). One unsieved sample from 4.0 feet bswl will be analyzed for TCLP Organics.

In addition to the above analyses, all samples collected from 0.5 feet bswl to 15.0 feet bswl, and every 10 feet thereafter until bedrock is encountered will be analyzed to determine CEC, SIEC, Eh, pH and buffering capacity. These samples will be unsieved. Concurrently, grain size distribution will be determined for these samples. Distribution coefficients (K_d) for chromium, lead, silver, mercury, barium, iron, manganese, magnesium and zinc will also be determined for selected samples along the cross-section at the outfall and at 0.6 miles, based on changes in the physical characteristics of the stratigraphic column at that location. Analysis of K_d will be in accordance with ASTM procedures (see Table A-3-2 and Table A-3-4).

3.4.1.4 Bore Holes at Center of IWD

Samples will be collected from the borings in the center of the IWD at depths of 1.5, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 9.0, 11.0, 13.0, 15.0 and 20.0 feet bswl, and every 10 feet thereafter until bedrock is encountered. The details of the drilling and collection of the samples will be worked out with the vendor and the appropriate SOPs will be written. NRF envisions that the drilling of the bore holes will be conducted using a large coffer dam to eliminate the surface water from the bore hole, in combination with grouting and a cased ODEX drilling system to drill through the saturated soil layer. This combination should eliminate the conduit to the ground water. All samples from these depths will be analyzed for Total Metals and will be unsieved. These samples will also be analyzed for TCLP Metals only if the threshold values described above are exceeded. Samples collected at 2.0, 4.0, and 9.0 feet bswl will be analyzed for TCLP SVOCs. These samples will be prepared for analysis using SOP-SC-11. The samples taken from 1.5, 3.0, and 6.0 feet bswl will be prepared for analysis using SOP-SC-11. That portion of the samples collected at 1.5, 3.0 and 6.0 feet bswl not passing through the sieve will be prepared in accordance with SOP-SC-12 and analyzed for Total Metals. These samples will

be analyzed for TCLP Metals only if the threshold values described above are exceeded. One unsieved sample collected from 4.0 feet bswl will be analyzed for TCLP Organics.

All samples collected from 1.5 feet to 15.0 feet bswl, and every 10 feet thereafter until bedrock is encountered, will be analyzed to determine CEC, SIEC, Eh, pH, and buffering capacity. These samples will be unsieved. Concurrently, grain size distribution will be determined for each of these samples.

Distribution coefficients will be determined for chromium, lead, silver, mercury, barium, iron, manganese, magnesium, and zinc in accordance with ASTM procedures (See Table A-3-3 and Table A-3-4). The depth from which these samples will be taken will be determined based on changes in the physical characteristics within the stratigraphic column at various bore hole locations.

3.4.1.5 Physical Sampling QA/QC

Table A-3-4 shows the number of QA/QC samples that will be collected for bore hole investigation. This Table also includes the total number of samples that will be collected for bore holes at 0, 2, 10, and 50 feet assuming the depth of bedrock is 50 feet.

3.4.2 Perched Water Exploration

Exploratory bore holes will be drilled to more accurately locate the boundaries of known perched water bodies, and to establish the presence or absence of additional perched water bodies. Up to five additional bore holes will be drilled in the area of wells PS-1 and PS-6 in accordance with SOP-DR-10, SOP-DR-18 and SOP-DR-21. The exact number of bore holes and their locations will be determined by the results of the geophysical investigations discussed in Section 3.3.2 and Work Plan Section 4, and will be approved by IDHW and EPA.

Prior to completion of wells, all perched water that is encountered will be sampled in accordance with SOP-SC-5 and analyzed for selected Total Metals, VOCs, and SVOCs in accordance with Sample Data Sheets 2, 17 and 29 (see Appendix E). After the well is completed and developed, additional water samples will be collected and analyzed for the same parameters as above. The wells will then be sampled on a routine basis in accordance with Schedule A or B and D (Section 3.9) based upon the location of the well.

Table A-3-3 Proposed Analyses in Cross-section Bore Holes at Center of IWD

Proposed Analyses*	Depth in Feet Below Static Water Level								
	1.5	2.0	3.0	4.0	5.0	6.0	7.0	9.0	11, 13, 15, 20, +10 UBR
Grain Size Distribution	*	*	*	*	*	*	*	*	*
Distribution Coefficient for Cr, Pb, Ag, Hg, Ba, Fe, Mn, Mg	*	*	*	*	*	*	*	*	*
Physical Characteristics	*	*	*	*	*	*	*	*	*
Total Metals - Unsieved	YES	YES	YES	YES	YES	YES	YES	YES	YES
Total Metals - Sieved	YES		YES			YES			
Total Metals - Gravel and Sand Rinsate	YES		YES			YES			
TCLP Metals - Sieved[x]	X	X	X	X	X	X	X	X	X
TCLP Metals - Unsieved[x]	X	X	X	X	X	X	X	X	X
TCLP SVOCs Sieved		YES		YES				YES	
TCLP VOCs and SVOCs Unsieved				YES					

UBR = until bedrock is reached

*The number and depth of samples will be determined by the Project Engineer

[x] Selected TCLP Metals analysis will be performed on each sample that exhibits a Total Metals Analysis result that is 20 or more times higher than TCLP limits

Table A-3-4 Bore Hole Summary Table With QA/QC

SUMMARY SAMPLES FOR HYDROGEOLOGIC STUDY						
TEST	# OF SAMPLES @ 0'	# OF SAMPLES @ 2'	# OF SAMPLES @ 10'	# OF SAMPLES @ 50'	QA/ QC	TOTAL
Grain Size Distribution	*	*	6	10	5	75
Physical Characteristics	*	*	2		10	50
Total Metals - Sieved	15	28	4		10	57
TCLP Metals - Sieved	3	10	2		3	18
Distribution Coefficient for K_d	*	*			10	50
Total Metals - Unsieved	3	6	2		2	13
TCLP Metals - Unsieved	3	6	2		2	13
Total Metals - Rinsate	3	4			2	9
SVOCs - Sieved	3	4			2	9
VOCs and SVOCs - Unsieved	1	2			1	4

All sample numbers based on depth of bedrock of 50 feet.

*The number and depth of samples will be determined by the project engineer.

Each hole will be logged using geophysical equipment. This will include video log, gamma log, gamma-gamma log, neutron/density log, and caliper log. If the red marker bed is encountered, it will be sampled and analyzed for Total Metals, VOCs, and SVOCs. K_d for chromium, silver, and mercury and CEC will also be determined. The lithology of each exploratory hole will be described from the cuttings.

All completed wells will be cased using three inch inside diameter, schedule 40 polyvinyl chloride (PVC) pipe (see SOP-DR-21). The screen interval will be gravel packed using 10/20 mesh silica sand, and the screen will be 10 slot factory PVC. Once complete, each well will be developed and pump tested, providing enough water is present. The transmissivity of the well will be estimated using an appropriate model. Slug tests will be performed on those wells in which the depth of water is too shallow to perform pump tests (see Work Plan Section 4). The slug test method will vary, depending on the hydraulic characteristics of each well.

3.4.3 Additional Slug Tests

During the fall of 1991, unsuccessful pump tests were performed on wells PS-1 and PS-6. The water depth in these wells was too shallow to pump. Slug tests will be performed to acquire the information needed to determine the transmissivity of these wells. The slug test method will vary, depending on the hydraulic characteristics of each well.

3.5 IWD Water Infiltration Study

An infiltration study will be performed on the IWD to determine the flow volume through different segments of the IWD. This data will be used to determine infiltration rates and volumes. The goal of this study is to determine the area of maximum infiltration to the nearest 200 feet. This study may be conducted in several rounds, each of which will last for at least one month. This approach may minimize the number of measuring devices needed. Measuring devices will be installed at five locations spaced approximately 2300 feet apart. The first measuring device will be located at the outfall. The next four measuring devices will be placed at approximately 2300, 4600, 6900, and 9200 feet from the outfall. The flow volumes for each interval will be compared. If the round 1 work shows that infiltration is uniform along the IWD, this study will end. However, if this study shows that various segments of the IWD are losing more water than others, a second round will be initiated.

During round 2 work, measuring devices will be installed in those segments identified during round 1 as having high infiltration rates. One device will be installed at the beginning and another will be placed at the end of each segment studied. Three additional devices will be placed at approximately 575, 1150, and 1725 feet, from the beginning of the segment.

A third round of work will be conducted if round 2 work indicates that one or more of the sub-segments of the IWD demonstrate unusually high leakage through its channel. From three to five measuring devices will be installed in the 575 foot sub-segments.

3.5.1 Discharge

The outfall measuring device will be used to record all flow entering the IWD. This device will be calibrated and will have a water level recorder installed so that flow plots can be made of the amount of water discharged to the IWD.

Routine log sheet readings taken daily since 1990 indicate that leakage from the sewage lagoon may be substantial, and may cause a significant stress on the underlying hydraulic system. Therefore, the amount of water being discharged into the sewage lagoon will be determined. A meter is presently connected to the sewage lagoon inlet line. This information will be evaluated during the RI/FS process. Section 2.2.3 of the Work Plan contains a brief discussion of the interaction between the sewage lagoons, the IWD, and perched water, and an estimate of the discharge from the sewage lagoons.

3.6 Computerized Ground Water Modeling

The existing data does not indicate that a detailed ground water modeling effort is necessary at this time. However, if the results of the ground water and sediment sampling efforts indicate that there are some data gaps such as contaminant fate and transport that are still unresolved, computer ground water modeling may be performed. The decision to model and the determination of model objectives and selection criteria will be made by NRF with review by IDHW and EPA. Section 4.4.5 of the Work Plan discusses potential modeling efforts.

3.7 Water Level Monitoring

Water level data recorders connected to pressure transducers will be installed in the NRF perched water wells to measure fluctuations in water level with time. The water level measurements of wells PS-1, PS-5, PS-6, PS-7, and PS-9 will be taken in accordance with SOP-IO-15. Samples will be collected at six hour intervals for the first month after installation of the data loggers,. At the end of the first month, the recorded data will be analyzed to determine the most appropriate sample rate. Data will be collected from these wells for at least one year; then data needs will be reassessed. The data gathered from this study will provide essential information on the hydrology of the perched water zone, and the hydraulic interactions between the IWD and the perched water zones (see Work Plan Section 4).

3.8 Field Survey of the IWD

The physical features of the IWD must be characterized. The first step in this characterization is to establish the centerline of the IWD from the outfall to 3.2 miles. The survey crew will place permanent markers every 100 feet, with reference signs attached to mark the distance from the outfall. This will provide future sample collection reference points for the RI/FS. The cross-section of the IWD from the outfall to the end is subject to variations in construction, flora, and dredging. The irregular cross-section and slope of the channel affects the flow and detention time through that section of the IWD. The IWD will have a complete survey made along its length with cross-sections made every 250 feet. These cross-sections will extend laterally 500 feet from the IWD to aid in predicting the potential runoff entering the IWD (see Work Plan Section 4).

3.9 Geochemical Analyses

3.9.1 Introduction

Perched water found in the shallow piezometer wells adjacent to the IWD, water from the Sewage Lagoons, the Sewage Lagoon piezometer well, and water from the IWD will be sampled. Results from the analyses of these samples will be compared to determine the most likely sources of water present in the NRF-6 PS-1, 5, 6, 7, and 9 wells, and to further define the hydraulic interaction between the sewage lagoon, the IWD, and perched water (see Section 2.2.3 for a more detailed discussion on the IWD/sewage lagoon interaction). Data gathered from the analyses of the water will provide valuable information about the hydrogeologic characteristics of the lithology beneath the IWD. This information will also provide data on the geochemical properties of the strata beneath the IWD, and will aid in determining the effect that precipitation has on the geochemistry and physical properties of the perched water bodies. Analyses of the perched water will also determine if contamination is present.

Data quality objectives for this study involve the use of EPA 600 methods for determining the concentrations of ions, anions, metals, and nutrients, and assessing contaminant levels in surface and ground water. The presence of Fecal Coliform will be determined using the Membrane Filter Procedure, Standard Methods, 17th ed. All geochemical data will be EPA Level 3.

Numerous samples of water and sediment in the IWD have been taken. Results from the analysis of these samples are located in Field Log Books (FLBs) numbers 1 through 5, 17, 18, 21, and 22. Several samples were taken from wells PS-1 and 5 during the summer of 1991. The final results from analysis of these samples are summarized in the 1991

Chen-Northern Report. Additional rationale for sampling the perched water zone is presented in Section 4.4.3.2 of the Work Plan.

3.9.2 Site and Sample Location

Samples will be collected at the NRF IWD, wells PS-1, PS-5, PS-6, PS-7, and PS-9, the east sewage lagoon, and the SL-1 perched water well. The IWD will be sampled at the outfall and 300, 600, 900, 1200, 1500, 1800, 2100, 2700, and 3300 feet away from the outfall. These sample locations are illustrated in Figure A-3-4.

3.9.3 Analyses

The type of analyses conducted for this project can be separated into two categories: analyses to establish whether or not the perched water zones are contaminated; and analyses to determine the geochemistry of water in and beneath the IWD to determine the source of water in the perched water wells.

Analyses in the first category include Total Metals, VOCs, SVOCs, and Fecal Coliform. Samples will be collected in accordance with Schedules A, B, and C of Figure A-3-5 through Figure A-3-7.

Analyses contained in the second category include common ions and nutrients. For efficiency, these analyses have be sub-divided into three levels. These levels differ in the number of constituents analyzed. The breakdown for each level is presented in Table A-3-5. The different levels of analysis appear on the sampling schedule as 1 (most constituents), 2, and 3 (least constituents). The boxes marked with an X in Table A-3-5 indicate which constituents will be included in the analyses for each level. Analytes contained in the level 3 list are those which are termed "major ions", and represent ions used to construct a Stiff Diagram. The Stiff Diagram is a graphic representation of water quality characteristics. Analytes contained in the level 2 list are major ions plus a selection of secondary and minor ions. This analytical suite is intended to identify a unique chemical signature for water samples taken from various portions of the IWD. The level 1 list encompasses all the constituents in the other two lists plus organic and nutrient constituents. The level 1 analyses will be performed on water which has a suspected lagoon source component. Figure A-3-5 identifies three sampling schedules. Each schedule applies to a different set of wells: Schedule A for PS-5 and PS-6; Schedule B for wells PS-1, PS-7, and PS-9; and Schedule C for the sewage lagoon and SL-1 well (see Work Plan Section 4).

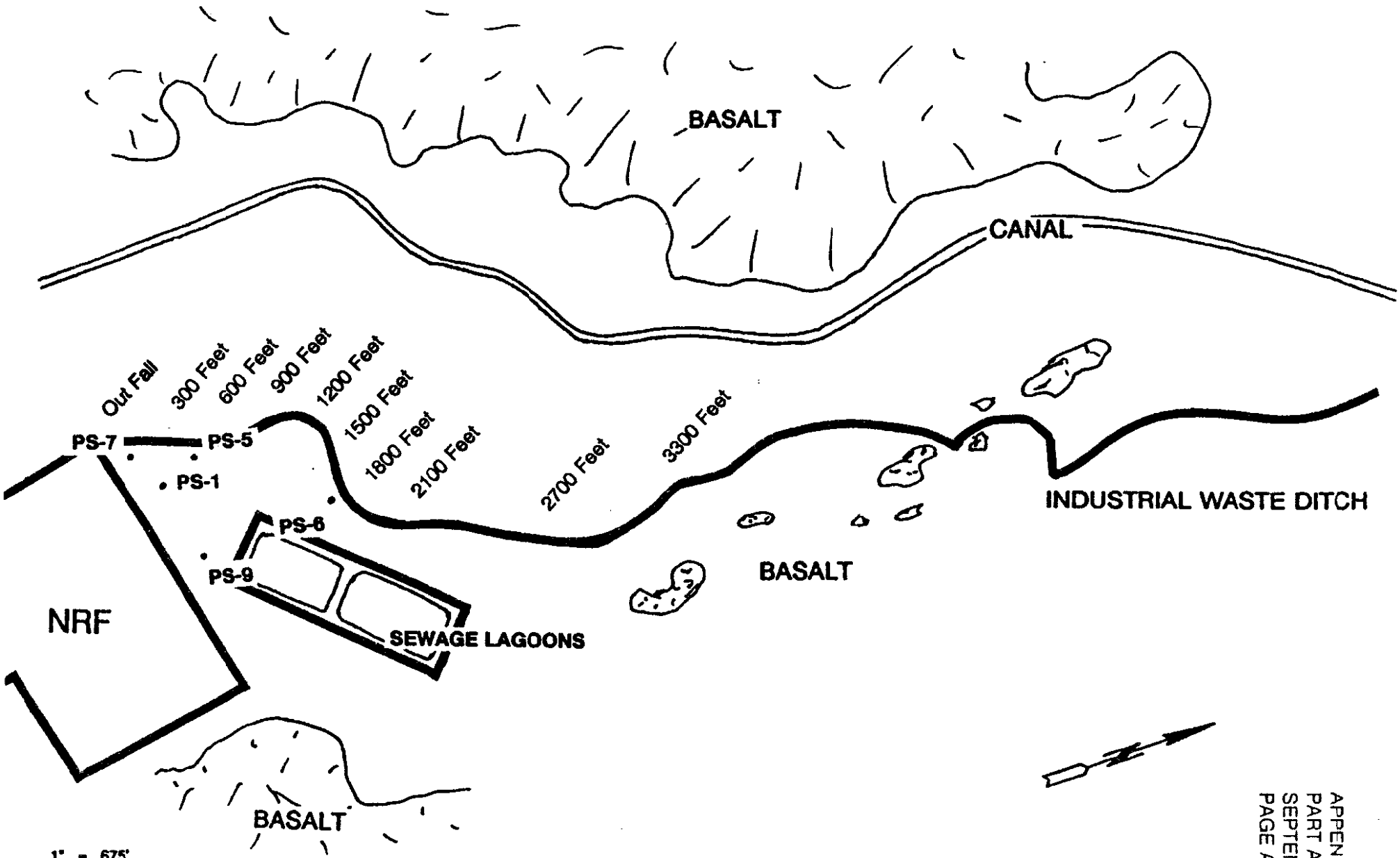

Figure A-3-4 Industrial Waste Ditch Water Sample Locations

Table A-3-5 Description of Ground Water Analyses

Analyte	* Method	1 (a)	2 (b)	3 (c)	Analyte	* Method	1 (a)	2 (b)	3 (c)
Br^-	300.0	X			$NO_2^- + NO_3^-$ as N	353.3	X	X	X
Cl^-	325.3	X	X	X	NO_2^- as N	353.2	X	X	X
F^-	340.2	X			Total K_jN	351.3	X		
HCO_3^-	310.1	X	X	X	NH_3 as N	350.2	X		
CO_3^{--}	310.1	X	X		TPH	418.1	X		
PO_4^{---}	365.3	X			BOD_5	450.1	X		
SO_4^{--}	375.4	X	X	X	o - phosphate	365.3	X		
Ca^{++}	215.1	X	X	X	Total P	365.3	X	X	
Mg^{++}	242.1	X	X	X	TDS	160.1	X	X	
Na^+	273.1	X	X	X	Alkalinity as $CaCO_3$	310.1	X	X	
K^+	258.1	X	X	X	Hardness	130.2	X	X	
Al^{+++}	202.1	X	X		Total Fe	236.1	X	X	
Ba^{++}	208.1	X	X		Total Mn	243.1	X	X	
Zn^{++}	289.2	X	X		SiO_2	370.1	X	X	

These analyses will be performed by Chen Northern.

* Methods used are from "Methods for Chemical Analysis of Water and Wastes" EPA-600/4-79-020

(a) Level 1 - Analysis - All analytes
(b) Level 2 - Analysis - Major and minor ions
(c) Level 3 - Analysis - Major ions needed for Stiff diagram

SCHEDULE A - WELLS PS-5 & PS-6

	1*	2	3	4	5	6	7	8	9	10	11	12	13	14
Metals	X[v]					X						X		
VOCs	X[v]											X		
SVOCs	X[v]											X		
Coliform														

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
					X		X		X		X		X	
					X						X			
					X						X			
					X[a]				X[a]				X[a]	

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
X		X				X				X				X
		X												X
		X												X
		X[a]												X[a]

45	46	47	48	49	50	51	52
	X		X		X		X
			X[a]				X[a]

X	FILTERED vs UNFILTERED
a	WELL 6 ONLY
b	WELL 9 ONLY
c	WELL 7 & 9 ONLY
d	LAGOON PIEZOMETER ONLY
V	APPENDIX VIII CONSTITUENTS
*	NUMBERS ACROSS TOP REPRESENT WEEKS

Figure A-3-5 Geochemical Chemical Sampling - Schedule A

SCHEDULE B - WELLS PS-1, PS-7 & PS-9

	1*	2	3	4	5	6	7	8	9	10	11	12	13	14
Metals	X[v]					X						X		
VOCs	X[v]											X		
SVOCs	X[v]											X		
Coliform	X[b]											X[b]		

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
					X				X				X	
					X									
					X									
					X[c]				X[c]				X[c]	

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
		X				X				X				X
		X												X
		X												X
		X[c]				X[b]								X[c]

45	46	47	48	49	50	51	52
	X		X		X		X
			X[a]				X[c]

X	FILTERED vs UNFILTERED
a	WELL 6 ONLY
b	WELL 9 ONLY
c	WELL 7 & 9 ONLY
d	LAGOON PIEZOMETER ONLY
V	APPENDIX VIII CONSTITUENTS

Figure A-3-6 Geochemical Chemical Sampling - Schedule B

SCHEDULE C - SEWAGE LAGOON & SEWAGE LAGOON PIEZOMETER WELL; IWD at OUTFALL & 600 YARDS

	1*	2	3	4	5	6	7	8	9	10	11	12	13	14
Metals	X[dv]													
VOCs	X[dv]													
SVOCs	X[dv]													
Coliform	X											X		

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
									X[d]					
									X[d]					
									X[d]					
					X								X	

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
						X								X

45	46	47	48	49	50	51	52
			X[d]		X		
			X[d]				
			X[d]				
							X

X	FILTERED vs UNFILTERED
d	LAGOON PIEZOMETER ONLY
V	APPENDIX VIII CONSTITUENTS
*	NUMBERS ACROSS TOP REPRESENT WEEKS

Figure A-3-7 Geochemical Chemical Sampling - Schedule C

SCHEDULE D - ALL LOCATIONS - ION & NUTRIENTS ANALYSES

SAMPLE SITE	1*	2	3	4	5	6	7	8	9	10	11	12	13	14
PS5	2	2	2	2	2	3	3	2				2		
PS6 & 9	1	1	1	1	1	3	3	3				1		
PS1 & 7	2			2				2				2		
IWD	2	2i	2	2i	2	3i	3i	2				2		
LAGOON/SL1	1	1	1			1						1		

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	2	3	3	3	2	2	2	2	2	2	2	2	2	2
	2	3	2	2	1	1	1	1	1	1	1	1	1	1
	2				1	3	1	3	1	3	1	3	1	3
	2	3i	2	2i	2	2i	2	2i	2	2i	2	2i	2	2i
	1				1				1				1	

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
2	2	2	3	3	3	2				2				2
1	1	1	2	2	3	3				1				2
1	3	1				2				2				2
2	2i	2	2i	2	3i	2				2				2
		1				1								

45	46	47	48	49	50	51	52
3	3	3	2	2	2	2	2
3	3	3	2	2	2	2	2
			2				2
3i	3i	2	2i	2	2i	2	2i
1				1			

3	MAJOR IONS
2	(3) + MOST SECONDARY + SOME MINOR IONS
1	(2) + NUTRIENTS
i	@ 300, 400, 600 & 700 YARDS ONLY
*	NUMBERS ACROSS TOP REPRESENT WEEKS

Figure A-3-8 Geochemical Chemical Sampling - Schedule D

3.9.4 Sampling Specifics

Three main systems will be sampled; the sewage lagoon, the shallow perched water wells, and the IWD.

3.9.4.1 Sewage Lagoon

The sewage lagoon system includes the northeast sewage basin and the SL-1 shallow piezometer well. The sample will be taken from a location at approximately one third the distance between the bottom of the sewage lagoon and the water surface in the center of the basin. This will require the use of a rowboat. Samples will be collected from the sewage lagoon in accordance with SOP-SC-6. The sample from the sewage lagoon well will be taken from the upper several feet of the water column in accordance with SOP-SC-8.

3.9.4.2 Shallow, Perched Water Wells

A total of five shallow, perched water wells will be sampled. These wells include NRF-6PS-1, PS-5, PS-6, PS-7 and PS-9. Samples will also be extracted from NRF-6PS-2 and PS-3 if water is present. Neither of these wells have contained water previously. The actual sample from each well will come from the upper several feet of water in the well. If the well to be sampled does not contain sufficient water to allow the use of an electric pump, a manual bailer will be used. SOP SC-7 will be used if the electric pump is used. SOP-SC-8 will be used if the bailer is used to collect the samples.

Some samples analyzed for metals will be split so that both filtered and unfiltered samples are collected. The comparison of the results of these two samples will allow NRF to assess the contaminant concentration contributed by suspended solids in the water. The filtration will be performed in accordance with SOP-SC-10 as close to the time of collection as feasible. Shaded blocks indicate samples that will be filtered. Figure A-3-5 provides a schedule for sampling water from the IWD, the sewage lagoon, and the perched water system, including the plan for filtered versus unfiltered metals samples. The numbers at top of each schedule represent the number of weeks from the starting date of February 10, 1992. Subscripts and superscripts are used to signify special analyses requirement.

3.9.4.3 Industrial Waste Ditch

The IWD will be sampled at 10 locations: 0, 300, 600, 900, 1200, 1500, 1800, 2100, 2700, and 3300 feet from the outfall. Zero feet is defined as the outfall culvert which discharges into the IWD. The exact sample location for each distance will be chosen to minimize the amount of plant matter in the vicinity of the sample. Therefore, the precise location may vary ± 20 feet from the above yardage values. The exact locations will be documented in the FLB. SOP SC-9 will be used when collecting these samples.

3.9.4.4 Sampling Schedule

The geochemical sampling of the various water bodies described in section 3.9.3 will be collected in accordance with the four schedules shown in Figures A-3-4 through A-3-8. The schedules designated A through C are specific for a given set of wells and Schedule D is specific for a given set of analyses.

Schedules A, B and C define the collection time and required analysis of samples for the purpose of determining to what degree the water samples contain contaminants. Each schedule is the same in that they all require Metal, VOC, SVOC, and Coliform samples to be taken. They differ only in the number of samples to be collected over a 52 week period.

It is assumed that wells PS-1, 5, 7, and 9 are completed in one perched water body and well PS-6 is completed in another. Since well PS-5 is the closest perched water well to the IWD outfall, it should contain the highest concentration of contaminants. Also, PS-5 is a more prolific water producer than PS-7. For these reasons, Schedule A for wells PS-5 and PS-6 collect samples more frequently than for the other wells. Wells PS-1, PS-7 and PS-9 (Schedule B) are further from the IWD and are thus sampled at less frequent intervals. Schedule C defines the sampling frequency for the sewage lagoon, the IWD, and the sewage lagoon piezometer well. Because NRF does not expect contaminants to be contained in any of these waters, samples from these sites will be collected at less frequent intervals. Furthermore, because of the distance between the sewage lagoon and wells PS-5, 6 and 7, coliform samples will not be collected from these locations.

Schedule D defines both the analyses required and the timing of the analyses for samples collected for the purpose of

determining the source of water in a given well location. It is assumed that two separate perched water zones are present. Examination of Schedule D shows variations in the level of analyses (i.e., level 3, 2 or 1), location, and timing. There are several reasons for this degree of complexity.

First, schedule D was designed to be cost effective. Second, for the perched water zones being considered, there are two probable and one possible source of water. These are the IWD, the sewage lagoon, and precipitation infiltration. For the purposes of this study, the contribution from precipitation is assumed to minimal. Wells which are furthest away and/or hydraulically up gradient from a given source are least likely to contain water from that source. Therefore, Schedule D matches sample levels so that both the suspected source and the suspected accumulation point are analyzed for the same constituents.

3.9.4.5 Sampling Timing

Schedule D shows that sample collection is more frequent during weeks 1 through 8, 16 through 36, and 44 through 52. This is done so that a comparison can be made of data collected during the transition in season from fall to winter and spring to summer. These are the time periods in which changes in temperature, precipitation and biological activity are the greatest. Therefore, these are the periods when the geochemistry of the water should show the greatest change. The relatively long time interval in which increased frequency in sampling occurs is intended to account for uncertainties in weather and travel time of water from the surface to the perched water.

3.9.4.6 Sampling Location Variations

In Schedules A, B, C and D the 'X' which designates that a sample is due for a given week is superscripted with a qualifier which restricts the location of that sample. This is done to minimize the collection of information which is not needed and thus reduce the cost of the sampling program.

4.0 MANAGEMENT OF FIELD GENERATED WASTES

Wastes generated during the field activities defined in this Field Sampling Plan (investigation derived wastes or field generated wastes) will be managed in accordance with the EPA Guide to Management of Investigation-Derived Wastes (Publication No. 9345.3-03FS) and the INEL FFA/CO Guidance (DOE-ID letter AM/SS-ESB-92-236 dated June 11, 1992). In general, all wastes generated within 50 feet of the ditch bank will be treated as hazardous until samples are analyzed or unless there is existing data to show that they are not hazardous. Wastes generated from activities 50 feet or more from the ditch banks will be treated as non-hazardous. These activities may include bore hole drilling for hydrogeologic investigations and background sampling evolutions. The field generated wastes will fall into four categories: purge water from ground water sampling, rinsate from equipment decontamination, soil and drill cuttings from drilling, auguring, and sampling activities, and non-indigenous wastes, such as disposable personal protective equipment, disposable sampling tools, etc. The management of each of these wastes is discussed below.

4.1 Purge Water

This category of waste includes water removed from the ground during purging operations performed prior to sampling and water pumped from wells during aquifer pump tests.

For wells where adequate existing sample results show that there are no hazardous constituents above regulatory levels, the water will be discharged to the NRF IWD or onto the ground. For existing data to be considered adequate, the data must have been collected over a sufficient period of time to determine if there are any temporal or seasonal trends. In general, this is considered to be at least 4 samples over a one year period. Additionally, the constituents for which analyses were performed must be considered. NRF has historically performed an extensive battery of tests on each well during the initial round of tests. This battery of tests include RCRA Appendix VIII analysis identified in 40 CFR Part 264 as Ground Water Monitoring List. Follow-up sampling includes only those constituents anticipated based on process knowledge. This level of testing is considered adequate for the determination of investigation-derived waste management.

For wells where the water has never been sampled before or where existing samples have had hazardous constituents above regulatory limits or increasing trends, the water will be containerized. Either 55 gallon drums or a portable collection tank will be used to contain the water until analysis results are received. If analysis results indicate that the levels of hazardous constituents are below regulatory levels, the water can be discharged to the NRF IWD. If the water is found to have hazardous constituents above the limits, the water shall be stored in an established storage area in or near the area of generation

until the remedial actions are initiated. The waste water will then be dispositioned along with other hazardous materials.

For wells where the water has been sampled, but there is doubt as to whether hazardous constituents exceed regulatory levels, the water shall be containerized as discussed in the paragraph above.

4.2 Rinsate From Decontamination Processes

Rinsate from the decontamination of sampling, drilling, and other equipment used within an area less that 50 feet from the banks of the IWD will be containerized and sampled to determine if the rinsate contains hazardous constituents that exceed regulatory levels. If the rinsate does not have hazardous constituents above regulatory levels, it may be disposed to the NRF IWD or to the ground. The only exceptions to this requirement are for background samples taken away from the suspected area of contamination, and for bore hole drilling for geologic data gathering 50 feet or more away from the banks of the IWD. In these cases, the rinsate may be disposed without sampling.

4.3 Soil From Sampling and Boring Operations

Soil and drill cuttings from bore holes and sampling in the IWD and less than 50 feet from the banks of the IWD shall be placed on poly sheets and covered until sample results are received. If the sample results indicate that no hazardous constituents above Land Disposal Regulation (LDR) Limits exist, the soil can be spread on the land surface next to or on the existing dredge piles. If the sample results indicate hazardous constituents are above the LDR levels, the soil shall be stored on the site until a remedial action is chosen and implemented. Disposition of soil will be included in all remedial action alternatives evaluated. For boring and sampling 50 feet or more from the bank of the IWD, the soil shall be returned to the hole.

4.4 Non-indigenous Field Generated Wastes

Non-indigenous wastes generated inside of the exclusion zone (EZ) or contamination reduction zone (CRZ) will be placed in dedicated refuse containers (55 gallon drums). Waste generated in the CRZ and EZ will not be disposed of until the results are received from sample analysis. If the soil and water sample analyses indicate that the non-indigenous wastes are contaminated with RCRA hazardous waste, then they will be managed in accordance with RCRA Subtitle C requirements and stored until the final remedy is selected and implemented. Non-indigenous wastes generated in the support zone will be placed in a separate container and disposed of routinely through the course of the project in accordance with NRF solid and hazardous waste minimization, management, and disposal procedures.

5.0 REFERENCES

Chen Northern Inc., 1991, IWD Hydrogeologic Investigation

DOE ID letter AM/SES-ESB-92-236, dated 6/11/92

EPA publication 9345.3-03FS, Guide to Management of Investigation-Derived Wastes, October 1991.

EPA, 40 CFR, Part 264 Federal Register, Vol. 52, No. 131, Thursday July 9, 1987.

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Site Health and Safety Plan for the IWD

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